A Modified Laptop Program: Putting the Carts in the Classrooms

Michael M. Grant
Steven M. Ross
Weiping Wang
Allison Potter
Yola Wilson
University of Memphis

Abstract

Four fifth grade classrooms embarked on a modified ubiquitous computing initiative in Fall 2003. Two 15-computer wireless laptop carts were shared among the four classrooms in an effort to integrate technology across the curriculum and affect change in student learning and teacher pedagogy. This initiative—in contrast to other 1:1 programs and stationary labs—offers public schools alternatives to budget constraints and instructional space overhead. Results indicate positive teacher technology competence and confidence, as well as instructional strategies that were student centered made meaningful uses of technology. Teacher pedagogical knowledge, technological knowledge and a supportive culture seem to be strong indicators for impacting technology integration in this context.

As access to computer technologies continues to increase (National Center for Educational Statistics, 2001), there has also been a movement to decrease the computer to student ratio, as well. Windschitl and Sahl (2002) report "more than a thousand schools nationwide have committed themselves to some form of laptop computer initiative" (p. 165). Goals of these types of initiatives vary, but include increased student achievement and learning, increased home and school interaction and increased technology access for low income families (Penuel et al., 2002).

A number of evaluations and case studies have documented mixed results with ubiquitous computing approaches (e.g., Edwards, 2003; Hill, Reeves, Grant, Wang, & Hans, in press; Lowther, Ross, & Morrison, 2003; Mowen, 2003; Rockman et al., 1997, 2000). Successes have included improved student achievements, broader access and equity for students, increased communications among faculty, administrators, students and parents and reports of reductions in absenteeism and school dropout rates. However, teachers and students alike struggled with managing learning issues, such as time on task; pedagogical issues, such as transitioning to student-centered learning; and classroom management issues, such as monitoring student distractions with email, the Internet and gaming.

Advocating a one-to-one student to computer ratio is appealing, and the goals are admirable. A similar statewide initiative (Bickford, Tharp, McFarling, & Beglau, 2002) has attempted to compromise on the student to computer ratio at two students to everyone one computer. However, this program has also been challenged with lack of change in teacher practice. And more recently, funding limits have placed the onus of support on the individual school districts.

The funding for such innovative programs cannot be discounted. Supplying every student and teacher with an Internet-capable computer is a substantial capital commitment for school budgets. One principal admits his middle school has "invested well over $1 million in laptop technology…since 2000" (Mowen, 2003, Introduction section, para. 3). For this reason many early laptop initiatives were implemented in private and parochial schools (e.g., Hill et al., in press; Newhouse, 2001; Rockman et al., 1997).

As an alternative to a one-to-one initiative for a select group of students, some schools have purchased mobile laptop carts. These carts of 5 to 25 mobile computers are typically wireless and can be wheeled from classroom to classroom as needed. Schools have used this model to promote collaboration among students and aid in transitioning among groups of students and in classroom settings (e.g., Gwaltney, 2003). In addition, these mobile carts have also offered an alternative to committing instructional space to computer laboratories.

Little research has been reported about these mobile laboratories. This small evaluation study presents the findings of one school's experience, identified with the pseudonym Green River Elementary, with using mobile laptop carts to affect change in teacher practice and student learning. The laptop program evaluation was structured around five primary research questions that focused on classroom practices, degree and type of technology use, academically focused time, student engagement, teacher technology skills, teacher attitudes toward technology, as well as student and teacher reactions to the program. The research questions were:

1. In what ways has the effectiveness of instruction through the use of student laptop computer been impacted?
2. To what degree and in what ways have teachers integrated technology with classroom instruction?
3. To what degree do teachers use methodologies that stress higher-order learning and student-centered learning activities?
4. To what degree has the laptop program impacted teacher attitudes toward technology?

Design

The evaluation design was based on both quantitative and qualitative data collected from classroom observations, teacher surveys, and focus groups with teachers and students. The four fifth grade teachers and their intact classrooms at Green River Elementary participated in the evaluation.

Context

Green River Elementary, serving grades K-8, was situated in a suburban city outside a large urban city in the southeast United States. The laptop program was a pilot project designed to determine the impact of changing the ways students learn and teachers instruct in a technology-enhanced learning environment. The original concept included a laptop for each student in fifth grade, replicating Rockman et al.'s (1997) concentrated implementation model, with dedicated technology integration training for the fifth grade teachers,. Unfortunately, costs and lack of significant grant funding prohibited the implementation of the project to this extent.

Instead, the context for the laptop program and this evaluation consisted of four fifth grade classes in which two Apple iBook wireless laptop carts were shared among the four fifth grade teachers' classrooms. In addition, the four teachers each received a personal Apple PowerBook laptop to use during the initiative and individually focused their professional development opportunities on technology-related training offered through the local school district. Each of the fifth-grade teachers taught one of the core subject areas, language arts, math, science and social studies. So every fifth-grade student rotated through each teacher's classroom during the day. The number of students per class ranged from 23 to 27.

Data Collection

Five instruments and focus group interviews were used to collect the evaluation data (three classroom observation measures, two teacher surveys and four interviews).

Classroom Observation Measures. Observations were made focusing on targeted classes (scheduled visits) using three instruments. Descriptive statistics were used for analyses. The *School Observation Measure (SOM©)* examined the frequency of usage of 24 instructional strategies, including traditional practices (e.g., direct instruction and independent seatwork) and alternative, predominately student-centered methods associated with educational reforms (e.g., cooperative learning, project-based learning, inquiry, discussion, using technology as a learning tool) (Ross, Smith, & Alberg, 1999). The observer summarized the frequency with which each of the strategies was observed on a data summary form. The frequency is recorded via a 5-point rubric that ranges from (0) Not Observed to (4) Extensively. Two global items used three-point scales (low, moderate, high) to rate, respectively, the use of academically focused instructional time and degree of student attention and interest. Targeted observations were conducted in this evaluation to examine classroom instruction during prearranged one-hour sessions in which the teachers demonstrated a prepared lesson using technology. Observation forms were completed every 15 minutes of the lesson then were condensed on a summary form. To triangulate the reliability of these results, multiple researchers observed class sessions.

The ***Survey of Computer Use (SCU©)*** examined availability of and student use of technology and software applications (Lowther & Ross, 1999). Four primary types of data were recorded: (a) computer capacity and currency, (b) configuration, (c) student computer ability and (b) student activities while using computers. Computer capacity and currency was defined as the age and type of computers available for student use and whether or not Internet access was available. Configuration refered to the number of students working at each computer (e.g., alone, in pairs, in small groups). Student computer ability was assessed by recording the number of students who were computer literate (e.g., easily used software features/menus, saved or printed documents) and the number of students who easily used the keyboard to enter text or numerical information. Student use of computers was focused on the types of computer-mediated activities, subject areas of activities, and software being used. The computer activities were divided into three categories based on the type of software tool (i.e., production tools, Internet/research tools, and educational software). The final section of the SCU was an "overall rubric" designed to assess the degree (1: Low-level use of computers, 2: Somewhat

meaningful, 3: Meaningful, 4: Very meaningful) to which the activity reflects "meaningful use" of computers as a tool to enhance learning.

Finally, the ***Rubric for Student-Centered Activities (RSCA©)*** rated the degree of learner engagement in cooperative learning, project-based learning, higher-level questioning, experiential/hands-on learning, student independent inquiry/research, student discussion, and students as producers of knowledge using technology (Lowther, Ross, & Plants, 2000). These strategies reflected emphasis on higher-order learning and attainment of deep understanding of content and whether or not technology was utilized as a component of the strategy. Such learning outcomes seemed consistent with those likely to be engendered by well-designed, real-world linked exercises, projects, or problems utilizing technology as a learning tool. Each item included a two-part rating scale. The first was a four-point scale, ranging from (1) indicating a very low level of application to (5) representing a high level of application. The second was a Yes/No option to the question: "Was technology used?" with space provided to write a brief description of the technology use.

Surveys. Two surveys were used to obtain self-perceptions of attitudes and skills. The *Teacher Technology Questionnaire (TTQ)* collected teacher perceptions of computers and technology. In the first section, teachers rate their level of agreement with 20 statements regarding five technology-related areas: (a) impact on classroom instruction, (a) impact on students, (c) teacher readiness to integrate technology, (d) overall support for technology in the school and (e) technical support. Items were rated with a five-point Likert-type scale that ranges from (1) Strongly Disagree to (5) Strongly Agree. A sixth section was added specifically to address perceptions of the laptop program also rated on a five-point scale from (1) Strongly Disagree to (5) Strongly Agree.

In addition, the *Technology Skills Assessment (TSA)* assessed the self-perceived technological abilities of the teachers in these areas: (a) computer basics, (b) software basics, (c) multimedia basics, (d) Internet basics, (e) advanced skills, (f) using technology for learning and (g) attitudes toward the laptop program. The survey consisted of 47 items with three levels (1:Not at All, 2: Somewhat, 3: Very Easily). All of the questions were aligned to the International Society for Technology in Education's (ISTE) National Educational Technology Standards (NETS).

Focus Groups. Focus groups were conducted with all four fifth grade teachers and eight to ten fifth grade students at the beginning of the initiative in Fall 2003 and again at the conclusion of the academic year in May 2004. A semi-structured interview protocol was used in order to variation in the order and phrasing of the questions, as well as probes to specific individuals (Patton, 1990). Questions addressed three areas: (a) use of laptop computers, (b) expectations for the laptop program and (c) reservations about the laptop program. Analysis of the data followed a general qualitative analysis process (Cresswell, 1998; Merriam, 1998). From audio recordings and facilitator notes, themes were derived from the participants.

Procedure

Data for this evaluation study were collected primarily in Spring 2004. The SOM, SCU and RSCA were completed for each targeted observations. These consisted of prearranged one-hour sessions in which the fifth grade teachers demonstrated a prepared lesson using technology. Observation forms were completed every 15 minutes of the lesson. A total of 9 visits across the four fifth grade classrooms were completed. The teacher surveys (TTQ and TSA) were administered in May 2004 prior to a focus group interview. Focus group interviews were conducted with students and teachers in Fall 2003 and again in May 2004.

Results

Below is a brief summary of the results grouped by Classroom Observation Results, Survey Results and Focus Group Results.

Classroom Observation Measures The data for 9 classroom observations were collected with SOMs, SCUs and RSCAs during prearranged sessions in which teachers implemented a lesson using technology. Results from each measure are described in the sections below.

School Observation Measure (SOM©). The SOM revealed nine instructional strategies that were observed during the targeted observations (N=9): (a) project-based learning, (b) technology as a learning tool or resource, (c) teacher acting as coach/facilitator, (d) independent seatwork, (e) cooperative/collaborative learning, (f) independent inquiry/research on the part of the students, (g) higher level instructional feedback to students, (h) use of higher-level questioning strategies and (i) direct instruction. These strategies were observed during 11.1% of the visits to 100% of the classroom visits. Project-based learning and technology as a learning tool or resource were observed during every visit (100%). Teacher acting as coach/facilitator and independent

seatwork were observed at least 50% of the time, 88.9% and 55.6% of the time respectively. Three more instructional strategies were observed in at least one third of the visits: cooperative/collaborative learning (44.4%), independent inquiry/research (44.4%) and higher-level instructional feedback (33.3). Academically focused class time and student engagement were observed to be high 100% of the time.

Survey of Computer Use (SCU©). In all of the visits (*N*=9) (100%), 11 or more computers were available for student use in the classrooms. All of the computers (100%) were observed to be up-to-date, and all the computers (100%) were connected to the Internet. It is important to note that during two of the pre-arranged visits, the school's internal network was intermittent. So while the computers were capable of accessing the intranet and Internet, students were unable to do so consistently. Student primarily worked alone (88.9%) and in pairs (11.1%). Computer literacy skills were observed to be consistently very good (100%), and keyboarding skills were also very good (100%). Three student computer activities were observed in at least 40% of the classroom visits: Internet browsers (66.7%), draw/paint/graphics (44.4%) and electronic presentations (44.4). Computer activities were observed in all subject areas. Productivity tool (i.e. word processing, draw/paint/graphics, spreadsheets, etc.) were observed in language arts (33.3%), mathematics (33.3%), social studies (22.2%) and science (11.1%). Internet/research tools were observed in language arts (22.2%), social studies (22.2%), mathematics (11.1%) and science (11.1%). Drill/practice/tutorial were the only educational software observed and only observed in mathematics (11.1%). Meaningful uses of computers were extensively observed in over 50% of the visits (55.6%) and very meaningful computer applications were extensively observed in over 30% of the classrooms (33.3%).

Rubric for Student-Centered Activities (RSCA©). Five of the seven activities noted on the RSCA were observed during visits (*N*=9): (a) project-based learning (100%), (b) students as producers of knowledge (88.9%), (c) cooperative learning (44.4%), (d) independent inquiry/research (44.4%) and higher-level questioning strategies (11.1%). Notably, project-based learning was observed during all observations and students as producers of knowledge were observed during almost 90% of the visits. The most meaningful applications of student-centered activities, that is those activities where somewhat strong and strong applications were observed in at least 30% of the classroom visits, included cooperative learning (44.4%), project-based learning (77.7%) and students as producers of knowledge (77.8%). Technology was used to support three of these strategies: project-based learning (100%), cooperative learning (44.4%) and independent inquiry/research (44.4%).

Survey Results

Two surveys (TTQ and TSA) were administered to the teachers prior to a focus group interview in May 2003. Results of the two surveys are presented below.

Teacher Technology Questionnaire (TTQ). The fifth grade teachers (*N*=4) responded very positively to the program. Mean scores for all six sections were between 4 ("Agree") and 5 ("Strongly Agree"). This indicates the teachers felt the laptop program has had a positive impact on (a) classroom instruction, (b) technology with students, (c) the teachers' readiness to integrate technology, (d) the school and district's overall support for technology, (e) appropriate technical support and (f) a positive attitude toward the laptop program. Notable are the questions that the teachers responded in unison. Within the section on overall support for technology in the school, two questions addressed the parent, community and administrative support necessary for technology to impact teaching and learning, both with scores of 5 = "Strongly Agree." Within the technical support section, the teachers concurred that they could readily answer technology related questions with a score of 4 = "Agree." Within the section on attitudes toward the laptop program, two questions represented the teachers' enthusiasm for the program and confidence about their abilities, both with scores of 5 = Strongly Agree. Also notable is a question, "School computers are well maintained," which received the lowest mean score of 3.75 between "Neither Disagree nor Agree" (3) and "Agree" (4). This question while receiving the lowest mean score also had the largest amount of variance among the respondents (*SD* = 1.26).

Technology Skills Assessment (TSA). The TSA revealed very high levels of confidence by the fifth grade teachers (*N*=4) to use technology throughout six basic areas: computers, software, multimedia, Internet, advanced skills, and using technology for learning. Teacher confidence was high in all six areas with mean scores of 2.5 or higher, between "Somewhat" and "Very Easily" and very little discrepancy among their ratings (*SD*=.05 to .38). The teachers rated themselves highest in Computer Basics (*M*=2.98) and Software Basics (*M*=2.96). Remarkable is that of the 47 questions on the TSA, the teachers rated their confidence in 30 of the tasks very easily, which constitutes 63.8% of the tasks. Moreover, of the 47 questions, only 4 questions were rated below 2 ("Somewhat").

Focus Group Results

Two focus group interviews each were conducted with the four fifth grade teachers and approximately 8 to 10 of the fifth graders. Initial interviews were conducted in Fall 2003 and follow-up interviews in May 2004. Interview questions centered on three topic areas: (a) uses of technology, (b) expectations of the initiative and (c) reservations with the initiative. Verbatim comments are enclosed in quotation marks to represent most accurately the voice of the students and teachers.

Teacher Focus Group. The teachers primarily discussed two themes: (a) computer use and (b) pressures and concerns.

Computer use. The teachers identified online tests, publishing stories, information seeking and research on the Internet, word processing, electronic presentations, and draw/paint applications as the computer uses they had implemented. They also considered it their responsibility to teach the students about trustworthiness with the laptops and the "upkeep" for the laptops. The teachers were proud of the very few numbers of computers that had been "dropped" by the students. They also felt in order to leverage the use of the laptops, it was necessary to teach "saving," "how to save" and management routines for using the laptops.

The teachers described that they would like to use the laptops for about "50%" of the time, about "two to three hours a day." However, they felt some challenges prevented them from achieving this goal. Specifically, the scope of the curriculum, as well as state and district standards (i.e., "student performance indicators"), was difficult to achieve with and without using the laptops. Changes in the district curriculum also made it "difficult to schedule" and plan ahead for the next year.

Pressures and concerns. In the fall semester, the teachers were concerned about the keyboarding skills of the students, as well as "maintenance," "upkeep" and "technical support" for using the laptops. However, in the spring semester, the teachers voiced that they were "confident" in the use of the laptops for instruction and that they could "figure out" most of the technical problems or questions that arose. They also noted that they depended on one another for expertise. Proximity to one another's classrooms facilitated this learning community.

Similarly, in the fall semester, they described that their colleagues were "jealous" toward the fact that they have laptops; however, their colleagues were relieved they "did not have to deal with the responsibilities and/or tasks" that accompany using the laptops for learning. In the spring, this perception continued. One teacher described it as "laptop envy." They felt that some teachers perceived the laptop program as an "extra burden." Indicative of their growth and comfort levels, however, the teachers noted that colleagues "come to us for questions" about using computers or technical problems, demonstrating pride in their accomplishments.

In the fall semester, the teachers expressed "meeting expectations of the administration" as pressure toward using the laptops, and "meeting standards" defined by the school district and state as pressures they felt toward not using the laptops. It is simple to discern the conflict these pressures presented toward use and non-use. However, in the spring semester they seemed to have reconciled these. The teachers concurred that they did not feel "as much pressure as in the beginning." Some pressure may have been intrinsic—applied by the teachers—in addition to the extrinsic pressures they identified. Again, pride in their endeavors seemed to have mitigated the former pressures.

In the fall semester, concerns about the laptop program centered on covering content and teaching skills and knowledge that specifically may not be revisited until later grades. The teachers were also concerned that they would be teaching computer skills that the students "will not use in other grade levels." In the spring, concerns shifted to improvements for the following school year. For example, another teacher would be added to the fifth grade. Currently, the core subject areas (language arts, mathematics, science and social studies) were taught by one of each of the fifth grade teachers. So, all the fifth grade students rotated through each of the teachers. In fall 2004, another teacher will be added and she will most likely share teaching responsibilities for one or more content areas. Integrating this teacher into the learning community and "logistically figuring it out" how to use the laptops when the same subject matter is taught in two different classrooms were indicated as challenges and concerns. In addition, technical difficulties, such as reliability with internal network, external Internet and server access, continue to be concerns for the teachers. They do feel, however, that they are more sensitive to these challenges given their reliance on these resources.

Student Focus Group. Students' discussions centered on two themes: (a) computer use and (b) students that benefit from using laptops.

Computer use. The students identified electronic presentations, writing "stories," graphing such as an ordered pairs lesson in mathematics, draw/paint to create an original flower in science and visiting Internet sites for information seeking/research as ways they had used the laptop computers in class. They said in many

instances using the laptop computers was "easier," "fun and faster" and required less "writing." But they also recognized that in some in cases, such as with the flower project in science, it was "harder" than completing the assignment on paper, where they previously used craft materials.

The students reported issues that they felt prevented from using them more in class. These related to technical and logistical topics as well as personal responsibility. Technical problems, such as system crashes, "freezing," glitches in the application programs, system updates, as well as broken keypads and broken cords requiring "repair time," continued to be challenges throughout the school year. Logistical issues primarily centered on lack of "battery power," which sometimes caused delays in instruction and in a few instances resulted in lost work.

A very strong theme for the students' use was personal responsibility for the laptops. This message as described by the teachers in their interviews appeared to have been respected by the students. Many students felt that they "had to be careful when using the laptops" so they would not damage them. They also felt that "not being responsible" would prevent them from being able to use them. Likewise, "dropping the laptops" was also a concern for the students. But, they also felt like they were "gaining responsibility" with using the laptops and taking care of them.

At the beginning of the school year, students thought typing, or keyboarding, skills were a problem for students, preventing use or slowing use. They even suggested requiring "a typing class." However, at the end of the year, the students did not include this with their challenges to using the laptops or with the students they felt benefited most from the laptops' use.

It is also interesting to note that a few students also felt that they "can't work on [the laptops] all day." They felt it was implausible. Similarly, students thought if they used the laptops "all day," it "might get boring."

Students that benefit from using laptops. The fifth graders felt that the types of students who benefited most from using the laptops were those that were fast learners or "students who learn more." They also thought those peers that had prior knowledge about computers or were "*into computers*" also benefited. In the fall they felt that students who had "high IQs" benefited, but in the spring, students mentioned that "students who are not as smart" were the ones benefiting most.

The students agreed in the fall and spring that the type of students who did not benefit from using the laptops were those students who "don't care" and those who "don't listen" or do not pay attention. One student called these indifferent and lackadaisical students "goofers," explaining that they "sit there and do nothing." They also felt that the "smartest kids in class" benefited least, because "they already know" how to use the laptops and are confident with the content. Similarly, the "fast learners" they felt should have additional resources, because they are "held back" when skills are retaught.

Discussion

The discussion of the findings of this study is presented in association with each of the major research questions in the respective sections below. The limitations associated with this study are relative to all qualitative research. The small sample limits the ability to generalize these finding to larger populations. More specifically, this research represents the voices of students and teachers in a suburban city, so it is impossible to say if these findings would extrapolate to other populations. As such, these results should be interpreted with caution, and the extent to which these results can be applied in other contexts is situated with the reader.

In what ways has the effectiveness of instruction through the use of student laptop computer been impacted?

While it is difficult to determine increases without baseline, or beginning, data, SOM results indicate extensive uses of cooperative/collaborative learning, project-based learning and the teachers acting as coaches or facilitators. Results from the SCU indicate extensive uses of productivity tools, specifically draw/paint/graphics and electronic presentations, and Internet research with Internet browsers. SCU results also suggest wide use across the content areas. Finally, the overall meaningfulness of the computers was observed to be extensive in approximately one-third to fifty percent of the classroom visits. The results from the SOM coupled with results from the SCU point to activities that result in meaningful uses of computers that were based on problems, required critical thinking skills and used computer applications to locate, process and/or manipulate information. Despite the limited scope of technology tools, those tools observed were seen to meaningfully integrate technology to enhance student learning.

Moreover, data from the RSCA revealed that teachers used technology with over 40% of their student-centered learning activities. This finding is not surprising given that the observations were conducted with targeted lessons, where the teachers were asked to demonstrate technology integration. However, specifically

notable is that technology was observed in every instance with project-based learning. This is a significant accomplishment given the focus of the initiative on using technology to impact teaching and learning. Plus, technology for student use is often employed best during more ill-defined learning contexts such as project- and problem-based learning (Morrison & Lowther, 2005).

It is important to indicate that during two of the observations as noted in the SCU, the school network access was intermittent. As the laptop program continues and potentially expands, school network reliability will affect the effectiveness of instruction with the increased dependence on digital resources, such as the Internet, email and school servers. Other implementations (e.g.,Edwards, 2003) have also experienced challenges with unstable or unreliable networks. While statistics may demonstrate promise for improving access to technology and digital resources (National Center for Educational Statistics, 2001), the reliability of school networks may impede or dissuade teachers from developing and implementing lessons that require Internet and intranet access.

To what degree and in what ways have teachers integrated technology with classroom instruction?

The proposed laptop program included comprehensive technology integration training for the fifth grade teachers; this was not implemented due to cost and lack of grants support. While no extensive training was conducted, the fifth grade teachers participated in a workshop on using Microsoft PowerPoint in Fall 2003 and informal discussions about classroom management with laptops during Spring 2003. Moreover, the teachers through focus group interviews indicated they had participated in professional development workshops offered through the local school district. They also relied heavily on one another to extend their expertise, creating an informal community of practice (Wenger, 1998) leveraged from their grade team. So, primarily the teachers used their educational philosophies and pedagogy to envision effective technology integration. Pierson (2001) suggests that pedagogical expertise and teacher epistemologies influence technology integration. Likewise, teachers' personal technology skills impact the meaningfulness of the technology integration activities as well as the instruction and assessment. While this evaluation did not seek to explore teacher epistemologies or pedagogical expertise, there is some evidence from observations and focus group interviews to suggest the fifth-grade teachers' visions for technology-enhanced teaching and learning represents the intersection of exemplary technological ability and exemplary teaching ability, Pierson's Category 4.

In the fall semester, both teachers and students mentioned keyboarding skills as impediments to technology-enhanced teaching and learning. As mentioned earlier, the students actually suggested requiring "a typing class." However, in the spring, keyboarding skills were not included as an obstacle to using the laptops computers more. SCU results reported keyboarding skills were very good in all classroom visits (100%). So student keyboarding skills seemed to have improved throughout the year and may be part of the learning curve for laptop initiatives.

To what degree do laptop teachers use methodologies that stress higher-order learning and student-centered learning activities?

In almost 90% (88.9%) of the targeted classroom visits, teachers were observed extensively to be acting as a coach or facilitator of learning. Other activities indicative of critical thinking and student engagement were seen in over 30% of the visits. Cooperative/collaborative learning, which was observed extensively in 33.3% of the visits, was observed to be a somewhat strong or strong application in over 40% of the observations (44.4%). Project-based learning, which was observed in 100% of the visits, was observed to be somewhat strong or strong application in over 75% of the visits (77.7%). Finally, independent inquiry/research, which was observed in over 40% of the visits (44.4%), was observed to be a somewhat strong or strong application in approximately 10% of the visits (11.1%). These data indicated some use of non-traditional, or more student-centered, instructional methods. Similar initiatives (e.g., Bickford et al., 2002) have reported challenges with teachers' uses of student-centered pedagogy. Pierson (2001) agreed that characterizations of exemplary technology-using teachers represent a combination of content knowledge, pedagogical knowledge and technological knowledge that few teachers may achieve.

The results from this research suggest the fifth-grade teachers have the pedagogical knowledge and skill to implement teaching methods that emphasize higher-order and critical thinking. While the observations used in this study were pre-arranged visits, it is impossible to determine the regularity of these strategies throughout the school year. In addition, with a lack of baseline comparative data, it is also impossible to discern whether the fifth-grade teachers employed these methods prior to the laptop initiative. However, professional development efforts or program goals focused more on these student-centered strategies may increase the frequency with which they are used.

To what degree has the laptop program impacted teacher attitudes toward technology?

The fifth grade teachers were enthusiastic about the laptop program. Succinctly, the teachers felt the

program had positively impacted their classroom instruction and positively impacted the fifth grade students. Moreover, the teachers felt they were ready to integrate technology into their instruction. This was corroborated by the focus group interviews as the teachers discussed their "confidence" with the laptops and reconciliation with previous intrinsic and extrinsic pressures. The TSA highlighted the teachers' expertise in computer basics, software basics, multimedia basics, Internet basics, advanced skills and using technology to support learning. This corroborates previous research (e.g., Pierson, 2001; Silvernail & Lane, 2004) that suggests teacher technology skills positively impact technology integration.

Personal professional development objectives or grade level professional development goals should consider the few technology skills, such as Boolean strategy searches, electronic communications other than email and electronic teaching portfolios, that received mean scores below 2 (between "Not at All" and "Somewhat"). These skills should be evaluated for their value to the teachers, students and relevance to the program as the initiative continues.

Finally, the teachers felt they have the support of parents, the community, the administration and the technical support necessary to be effective with technology integration and improve student learning. Silvernail and Lane (2004) reported that success with technology integration also appeared to be influenced by key individuals to champion the program. The parents and school administration, while initially imposing extrinsic pressure on the teachers, may in fact have translated into the types of advocates necessary to support the laptop program.

Conclusion

From the formative results in this study, the school had positive teacher technology competence and confidence, used instructional strategies that centered on and facilitated student learning and employed classroom practices that engaged students in meaningful technology-supported activities. Pierson's (2001) case studies emphasized content, pedagogical and technological knowledge as factors influencing technology integration. Windschitl and Sahl (2002) illuminated further this work by contending that teacher beliefs coupled with school culture and perceived support impact technology integration, specifically in laptop programs. In the present study, the fifth-grade teachers' progress toward more student-centered activities, including project-based learning, cooperative/ collaborative learning and acting as a coach or facilitator, seems to support this. The interdependence with one another and community of practice established by the fifth grade teachers also appears to have created an informal culture of support and knowledge sharing (Wenger, 1998). While the teachers may have been novices at the beginning of the school year, clearly all the teachers felt they were skilled enough to use a variety of software applications for meaningful learning. These three factors — teacher pedagogical knowledge, technological knowledge and a supportive culture — seem to be strong indicators for impacting technology integration at this school.

References

Bickford, A., Tharp, S., McFarling, P., & Beglau, M. (2002). Finding the right fuel for new engines of learning. *Multimedia Schools, 9*(5), 18-26.

Cresswell, J.W. (1998). *Qualitative inquiry and research design*. Thousand Oaks, CA: Sage.

Edwards, M.A. (2003, April). The lap of learning. *School Administrator, 60*, 10-12.

Gwaltney, T.L. (2003). *Year three final report of the Project M*^{3} (Preparing Tomorrows Teachers to use Technology Grant). Wichita, KS: Witchita State University.

Hill, J.R., Reeves, T.C., Grant, M.M., Wang, S.K., & Hans, S. (in press). Learning in a wireless environment: The successes and challenges of ubiquitous computing in a school. In C. Vrasidas & G.V. Glass (Eds.), *Current perspectives on applied information technologies: Preparing teachers to teach with technology* (Vol. II). Greenwich, CT: Information Age Publishing.

Lowther, D.L., & Ross, S.M. (1999). *Survey of Computer Use (SCU)*. Memphis, TN: Center for Research in Educational Policy, The University of Memphis.

Lowther, D.L., Ross, S.M., & Morrison, G.M. (2003). When each one has one: The influences on teaching strategies and student achievement of using laptops in the classroom. *Educational Technology, Research & Development, 51*(3), 23-44.

Lowther, D.L., Ross, S.M., & Plants, R. (2000). *Expanded Rubric (ER)*. Memphis, TN: Center for Research in Educational Policy, The University of Memphis.

Merriam, S.B. (1998). *Qualitative research and case study applications in education*. San Francisco: Jossey-Bass.

Morrison, G.M., & Lowther, D.L. (2005). *Integrating computer technology into the classroom* (3rd ed.). Upper Saddle River, NJ: Pearson Merrill Prentice Hall.

Mowen, G.G. (2003, April). Adventures in laptop land. *School Administrator, 60,* 14-16, 18-19.

National Center for Educational Statistics. (2001). *The digest of education statistics: 2001*. Washington, DC: US Department of Education.

Newhouse, C.P. (2001). A follow-up study of students using portable computers at a secondary school. *British Journal of Educational Technology, 32*(2), 209-219.

Patton, M.Q. (1990). *Qualitative evaluation and research methods* (2nd ed.). Newbury Park, CA: Sage.

Penuel, W.R., Kim, D.Y., Michalchik, V., Lewis, S., Means, B., Murphy, R., et al. (2002). *Using technology to enhance connections between home and school: A research synthesis* (DHHS Contract #282-00-008-Task1): Planning and Evaluation Service, US Department of Education.

Pierson, M.E. (2001). Technology integration practice as a function of pedagogical expertise. *Journal of Research on Computing in Education, 33*(4), 413-430.

Rockman et al. (1997). *Report of a laptop program pilot* (Online). San Francisco, CA.

Rockman et al. (2000). *A more complex picture: Laptop use and impact in the context of changing home and school access* (Online). San Francisco.

Ross, S.M., Smith, L.J., & Alberg, M. (1999). *The School Observation Measure (SOM)*. Memphis, TN: Center for Research in Educational Policy, The University of Memphis.

Silvernail, D.L., & Lane, D.M.M. (2004). *The impact of Maine's one-to-one laptop program on middle school teachers and students: Phase one summary evidence* (Online): Maine Education Policy Research Institute, University of Southern Maine Office.

Wenger, E. (1998). *Communities of practice: Learning, meaning, and identity*. Cambridge, U.K.: Cambridge University Press.

Windschitl, M., & Sahl, K. (2002). Tracing teachers' use of technology in a laptop computer school: The interplay of teacher beliefs, social dynamics and institutional culture. *American Educational Research Journal, 39*(1), 165-205.